

37. ZOOLOGY

DETAILS OF SYLLABUS

SECTION A

UNIT 1 - TAXONOMY AND ANIMAL DIVERSITY

Taxonomy

- 1.1 Classical taxonomy; Modern trends in taxonomy (numerical taxonomy, cladistic taxonomy, molecular taxonomy); phylogenetic tree.
- 1.2 Scientific classification of organisms (five kingdom and three-domain systems); biological nomenclature; ICZN.
- 1.3 Concepts of species and hierarchical taxa.

Animal Diversity

- 1.4 Broad classification of animal kingdom: Mesozoa, Parazoa and Eumetazoa (Radiata, Bilateria); Protostomia (Acoelomata, Pseudocoelomata and Eucoelomata), Deuterostomia.
- 1.5 Levels of organization (cellular, tissue and organ levels); Modes of coelom formation.
- 1.6 Salient features of the phyla: Mesozoa, Porifera, Cnidaria, Ctenophora, Platyhelminthes, Nematoda, Nematomorpha, Rotifera, Annelida, Echiurida, Mollusca, Onychophora, Arthropoda, Echinodermata, Chaetognatha, Phoronida, Hemichordata.

UNIT 2 - GENETICS

- 2.1 Mendelian principles: critical evaluation
- 2.2 Interaction of genes:
 - 2.2.1 Allelic interactions: incomplete dominance, codominance
 - 2.2.2 Non-allelic interactions: complementary gene action, epistasis, duplicate gene action.
- 2.3 Multiple alleles: coat colour in rabbits, Rh blood group inheritance
- 2.4 Polygenic inheritance (Quantitative inheritance) - Johansen's pure lines, skin colour in man.
- 2.5 Linkage and crossing over
 - 2.5.1 Linkage groups, complete and partial linkage.
 - 2.5.2 Crossing over and recombination - mechanism of crossing over, kinds of crossing over.
- 2.6 Extrachromosomal inheritance:
 - 2.6.1 Characteristics; maternal inheritance of cytoplasm, plastid genome, mitochondrial genome.
 - 2.6.2 Kappa particles in *Paramecium*.
 - 2.6.3 Maternal effects.
- 2.7 Sex linked inheritance: characteristics, examples: hemophilia, colour blindness; holandric genes.

- 2.8 Sex determination:
 - 2.8.1 Chromosomal basis and genic balance theory.
 - 2.8.2 Types of chromosomal mechanism.
 - 2.8.3 Dosage compensation, Barr bodies, Lyon hypothesis.
- 2.9 Human genetics: Genetic disorders in man
 - 2.9.1 Chromosomal anomalies (autosomal and sex chromosomal)
 - 2.9.2 Single gene disorders (autosomal and sex linked, inborn errors in metabolism)
- 2.10 Human genome project: objectives, major outcomes.

SECTION B

UNIT 3 - CELL AND MOLECULAR BIOLOGY

- 3.1 Cell membranes
 - 3.1.1 Membrane structure: Organization based on fluid mosaic model.
 - 3.1.2 Membrane transport - diffusion, active transport, ion pumps, bulk transport.
 - 3.1.3 Differentiation of cell membrane: microvilli, tight junctions, belt and spot desmosomes, gap junctions.
- 3.2 Cell organelles:
 - 3.2.1 Nucleus - nuclear envelope, nuclear pore complex, chromatin organization.
 - 3.2.2 Mitochondria - structure, mitochondrial oxidation (chemiosmotic theory, respiratory chain).
 - 3.2.3 Golgi apparatus - structure and functions.
 - 3.2.4 Lysosomes - structure (polymorphisms), functions.
 - 3.2.5 Endoplasmic reticulum: Structure and functions.
 - 3.2.6 Peroxisomes: Structure and functions.
 - 3.2.7 Cytoskeleton: Microtubules, microfilaments and intermediate filaments; molecular motors.
- 3.3 Cell cycle and regulation of cell cycle.
- 3.4 Chromosomal aberrations:
 - 3.4.1 Structural aberrations
 - 3.4.2 Numerical aberrations
- 3.5. Gene mutations:
 - 3.5.1 Types of mutation
 - 3.5.2 Molecular basis of gene mutations
 - 3.5.3 Radiation and mutagenesis.
- 3.6 Nucleic acids:
 - 3.6.1 DNA - structure
 - 3.6.2 Conformations of DNA
 - 3.6.3 DNA replication
 - 3.6.4 DNA repair.
 - 3.6.5 RNA - Types of RNA

- 3.6.6 Genetic code.
- 3.7 Genomes:
 - 3.7.1 Organization of viral genome
 - 3.7.2 Organization of prokaryotic genome
 - 3.7.3 Organization of eukaryotic genomes; split genes; selfish genes; pseudogenes; gene clusters and gene families; antibody diversity.
- 3.8 Transcription:
 - 3.8.1 Transcription factors
 - 3.8.2 Mechanism of transcription in prokaryotes and eukaryotes.
 - 3.8.3 Posttranscriptional processing in eukaryotes.
- 3.9 Protein synthesis:
 - 3.9.1 Mechanism (formation of initiation complex, elongation and termination)
 - 3.9.2 Post-translational modification of proteins.
- 3.10 Regulation of gene activity:
 - 3.10.1 In viruses (cascade mode of expression of early, middle and late genes)
 - 3.10.2 In prokaryotes (Lac operon, Trp operon)
 - 3.10.3 In eukaryotes.
- 3.11 Transposable elements:
 - 3.11.1 Bacterial transposons and mechanism of transposition.
 - 3.11.2 Eukaryotic transposons.
 - 3.11.3 Retroviruses and their transposition

UNIT 4 - TECHNIQUES IN MOLECULAR BIOLOGY AND BIOTECHNOLOGY

- 4.1 Microscopy:
 - 4.1.1 Light microscope
 - 4.1.2 Transmission electron microscope (TEM)
 - 4.1.3 Scanning electron microscope (SEM)
- 4.2 Electrophoresis
- 4.3 Chromatography
- 4.4 Gene amplification - vector-mediated (gene cloning) and vectorless (PCR)
- 4.5 Recombinant DNA technology:
 - 4.5.1 Vectors (plasmids, phagees, cosmids, BAC, YAC and shuttle vectors)
 - 4.5.2 Steps in gene cloning
 - 4.5.3 Tools used in recombinant DNA technology
- 4.6 Genomic and cDNA libraries
- 4.7 Probes and molecular markers: RFLP, AFLP, STRs, VNTRs; DNA fingerprinting.
- 4.8 Gene transfer in animals - different methods
- 4.9 DNA sequencing (Maxam-Gilbert, Sanger and automated methods)
- 4.10 Radioimmunoassay (RIA); ELISA.

- 4.11 Blotting techniques (Southern, Northern, Western)
- 4.12 Genetic engineering and its applications.

SECTION C

UNIT 5 - BIOCHEMISTRY

- 5.1 Energy rich compounds and their biological significance.
- 5.2 Metabolism of carbohydrates
 - 5.2.1 Glycolysis, energetics
 - 5.2.2 Krebs cycle, energetics
 - 5.2.3 Pentose phosphate pathway, biological significance
- 5.3 Metabolism of lipids
 - 5.3.1 Beta-oxidation of fatty acids.
 - 5.3.2 Biosynthesis of fatty acids.
- 5.4 Protein metabolism
 - 5.4.1 Urea cycle, regulation of urea cycle
 - 5.4.2 Deamination
 - 5.4.3 Transamination
 - 5.4.4 Decarboxylation.
- 5.5 Vitamins
 - 5.5.1 Classification
 - 5.5.2 Physiological functions and deficiency disorders of fat soluble vitamins.
 - 5.5.3 Physiological functions and deficiency disorders of water soluble vitamins.
- 5.6 Enzymes
 - 5.6.1 Classification
 - 5.6.2 Mode of action of enzymes
 - 5.6.3 Regulation of enzyme activity
 - 5.6.4 Enzyme inhibition.

UNIT 6 - PHYSIOLOGY

- 6.1 Nutrition
 - 6.1.1 Types of nutrition
 - 6.1.2 Digestion: mechanical and chemical
 - 6.1.3 Absorption of sugars, amino acids and fats
- 6.2 Respiration
 - 6.2.1 Respiratory pigments
 - 6.2.1 Transport of O₂ and CO₂, Bohr effect, chloride shift.
- 6.3 Body fluids and Circulation
 - 6.3.1 Types of heart
 - 6.3.2 Composition of blood
 - 6.3.3 Physiology of blood clotting

- 6.3.4 Electrical and mechanical properties of heart muscles
- 6.3.5 Control of cardiac activity.
- 6.4 Excretion
 - 6.4.1 Patterns of nitrogen excretion
 - 6.4.2 Structure of kidney, ultrastructure of nephron,
 - 6.4.3 Mechanism of urine formation
 - 6.4.4 Countercurrent exchanger system.
- 6.5 Muscle physiology
 - 6.5.1 Types of muscles
 - 6.5.2 Ultrastructure of skeletal muscle cell
 - 6.5.3 Muscle contraction.
- 6.6 Neurophysiology
 - 6.6.1 Structure of neurons
 - 6.6.2 Generation and transmission of nerve impulse
 - 6.6.3 Synapse and synaptic transmission
 - 6.6.4 Neurotransmitters.
- 6.7 Endocrine glands
 - 6.7.1 Classification of hormones
 - 6.7.2 Endocrine glands and hormones in man
 - 6.7.3 Neurosecretion
 - 6.7.4 Mode of action of hormones.
- 6.8 Sense organs
 - 6.8.1 Physiology of vision in man - ultrastructure of rods and cones,
 - 6.8.2 Photopigments, pigment cycle.
 - 6.8.3 Physiology of hearing and balancing.
- 6.9 Human reproductive system
 - 6.9.1 Male reproductive physiology: Anatomy and histology of adult testis
 - 6.9.2 Male accessory organs.
 - 6.9.3 Female reproductive physiology: Menstrual cycle (ovarian and uterine cycles)
 - 6.9.4 Menarche, menopause
 - 6.9.5 Pregnancy, parturition
 - 6.9.6 Lactation, hormonal control of lactation.

UNIT 7 - IMMUNOLOGY

- 7.1 Types of immunity:
 - 7.1.1 Innate and acquired immunity
 - 7.1.2 Humoral and cell-mediated immunity.
- 7.2 Cells and organs of immune system: Primary and secondary lymphoid organs.
- 7.3 Antigens and antibodies
 - 7.3.1 Structure of antibodies
 - 7.3.2 Antigen-antibody interactions.
- 7.4 MHC molecules: general organization and inheritance of MHC.
- 7.5 Antigen processing and presentation.

- 7.6 Hypersensitivity: elementary description and classification.
- 7.7 Immunodeficiency: Congenital and acquired
- 7.8 Autoimmunity.

SECTION D

UNIT 8 - DEVELOPMENTAL BIOLOGY

- 8.1 Types of egg; Influence of yolk on development.
- 8.2 Fertilization:
 - 8.2.1 Pre-fertilization events: sperm-egg encounter, cell surface molecules in sperm- egg recognition, acrosome reaction, sperm penetration.
 - 8.2.2 Post-fertilization events: response of egg to sperm penetration, cortical reaction, metabolic activation, fusion of pronuclei.
- 8.3 Parthenogenesis:
 - 8.3.1 Natural parthenogenesis (haploid and diploid)
 - 8.3.2 Artificial parthenogenesis and the factors inducing parthenogenesis.
- 8.4 Cleavage
 - 8.4.1 Types of cleavage
 - 8.4.2 Cleavage patterns
 - 8.4.3 Blastulation: types of blastula, midblastula transition.
- 8.5 Gastrulation:
 - 8.5.1 Fate map
 - 8.5.2 Cell movements during gastrulation.
- 8.6 Basic concepts of development:
 - 8.6.1 Potency of embryonic cells
 - 8.6.2 Competence, determination and differentiation
 - 8.6.3 Genomic equivalence
 - 8.6.4 Cytoplasmic control of nuclear activity
 - 8.6.5 Primary embryonic induction;
 - 8.6.6 Nieukoop centre and mesodermal polarity.
- 8.7 Organogenesis of brain and heart of frog.
- 8.8 Placenta - different types.
- 8.9 Experimental embryology:
 - 8.9.1 Constriction experiments
 - 8.9.2 Experiments on embryonic induction and competence
 - 8.9.3 Cloning experiments in animals
 - 8.9.4 *In vitro* fertilization and embryo transfer
 - 8.9.5 Prenatal diagnosis.

UNIT 9 - ECOLOGY, BIODIVERSITY CONSERVATION, EVOLUTION AND ETHOLOGY

- 9.1 Population ecology: characteristics, population growth curves;
- 9.2 Community ecology:
 - 9.2.1 Community structure and attributes

- 9.2.2 Edges and ecotones.
- 9.3 Ecosystem:
 - 9.3.1 Characteristics of ecosystem
 - 9.3.2 Structure of ecosystem
 - 9.3.3 Stability of ecosystem.
- 9.4 Food chain and food web.
- 9.5 Energy flow; Ecological pyramids.
- 9.6 Biogeochemical cycles: Gaseous cycles and sedimentary cycles.
- 9.7 Ecological succession: Types, changes involved in succession, concept of climax.
- 9.8 Animal associations:
 - 9.8.1 Types of interactions (Positive, negative and neutral)
 - 9.8.2 Lotka Volterra hypothesis.
- 9.9 Pollution
 - 9.9.1 Water pollution
 - 9.9.2 Air pollution
 - 9.9.3 Waste disposal
 - 9.9.4 Biomagnification: definition, mechanism, examples, effects on ecosystem.
- 9.10 Biodiversity and Conservation Biology
 - 9.10.1 Values of biodiversity
 - 9.10.2 Causes of biodiversity depletion
 - 9.10.3 Concept, aim and principles of conservation
 - 9.10.4 Conservation strategies (*in-situ* and *ex-situ* conservation)
 - 9.10.5 Biosphere reserves, Wild life sanctuaries and National parks.
 - 9.10.6 Forest conservation and wildlife management.
- 9.11 Evolution
 - 9.11.1 Origin and evolution of life
 - 9.11.2 Theories of evolution: Classical and synthetic theories of evolution.
 - 9.11.3. Mechanism of evolution; forces of evolution
 - 9.11.4 Neoteny; genetic drift; Bottle-neck phenomenon; Punctuated equilibrium.
 - 9.11.5 Species and speciation
- 9.12 Ethology
 - 9.12.1 Unlearned behaviour (reflex and instinct)
 - 9.12.2 Learned behaviour (imprinting, habituation, conditioned learning, trial and error, insight learning).

UNIT 10 - ECONOMIC ZOOLOGY

- 10.1 Insect pests:
 - 10.1.1 Pests of crops (coconut, paddy, rubber, sugar cane)
 - 10.1.2 Pests of stored food grains.
 - 10.1.3 Pest control - chemical, biological and other methods.
- 10.2 Silkworms and sericulture

- 10.2.1 Species of silkworms
- 10.2.2 Composition of silk
- 10.2.3 Sericulture: Silkworm rearing methods.
- 10.3 Honey bees and apiculture
 - 10.3.1 Species of honey bees
 - 10.3.2 Apiculture Beekeeping methods
 - 10.3.3 Useful products from honey bees and the importance of apiculture.
- 10.4 Fisheries and aquaculture
 - 10.4.1 Fish breeding techniques
 - 10.4.2 Fish culture
 - 10.4.3 Aquarium fishes and their economic importance
 - 10.4.4 Fishing crafts and gears
 - 10.4.5 Pearl culture.